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16. ABSTRACT

This report, which was directed by Congress, describes EPA's strategy for ensuring that there is an adequate supply of trained professionals to meet the environmental workforce needs in the U.S. The report describes EPA's mission and gives a historical perspective of graduate training support provided by EPA and its predecessor agencies. In describing EPA's priorities among various types of workforce development activities, the report cites conclusions reached in a 1977 study by the National Academy of Sciences on pollution control manpower and discusses factors affecting EPA support of academic training. One section discusses issues concerning academic training in toxic substances and related fields.

EPA workforce activities proposed in the study include: assessing the environmental job market and publishing 5-year forecasts of the needs in the environmental field; examining the use of State-EPA agreements to encourage professional workforce planning; determining shortages of trained professionals in toxicology and related fields; supporting university centers of excellence in the research fields of epidemiology, ground water protection, and advanced waste treatment techniques; establishing area training centers at selected educational institutions; testing combining selected research and training activities at a single location; establishing priorities among workforce development activities; and encouraging State sufficiency in environmental programs.

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TABLE OF CONTENTS

	PAGE
INTRODUCTION	i
EPA ACTIONS	ii
1. Background	1
2. Purpose of This Report	1
3. EPA's Mission	1
4. Historical Patterns of Graduate Training Support	1
5. Factors Affecting EPA Support of Academic Training	8
6. University Centers and EPA Support for Academic Training	9
7. Priorities Among Various Types of Workforce Development	11
8. Issues in Toxic Substances and Related Fields	12
FOOTNOTES	

INTRODUCTION

In the late 60's and 70's, due to a lack of a sufficient environmental workforce, the EPA began a program of providing financial assistance and support to various universities. The purpose of this assistance was to provide "seed money" for the development of special environmental curricula that would eventually increase the number of professionals in the environmental field. The effect of this program has been the establishment of environmental curricula at various academic institutions with the result being an increase in trained pollution control professionals. In light of this, EPA considers its mission accomplished and has thus ended its support of pollution control graduate training. However, EPA does not expect its withdrawal of funding to collapse the program, rather it feels that the free market is ready to take over. The following are the reasons for this belief:

1. As environmental enforcement is increased, it will force operators and managers to hire and/or train workers.

2. Approximately 1/2 of the States have air pollution (air quality management) control engineer course offerings, and most States have institutions offering sanitary engineering degrees.

3. EPA has concentrated resources at a few academic institutions to establish research centers of specialization. A natural expansion of training at these centers may be expected to follow.

4. Direct payments by the Federal Government to students to pursue whatever field they want are at an all time high of $8 billion. In addition, payments to institutions to encourage specific degrees amount to several hundred million dollars annually. This allows universities more financial security and also allows more people the opportunity to choose the environmental field.

5. EPA does not wish to cause an "overkill" effect similar to the post-Sputnik push for scientists and engineers in the 60's.

6. EPA is encouraging State self-sufficiency and assumption of primacy in environmental programs. Grants to support State control agencies have doubled in recent years.

EPA ACTIONS

EPA is proposing, or has accomplished, the following:

- EPA, having established an academic base, and a corresponding demand for environmental professionals, will allow the development of the workforce in the market place. Correspondingly, it will assume the role of an assessor of the environmental job market, and provide enhanced market knowledge to the public by publishing five (5) year forecasts of the needs in the environmental field periodically.

- EPA will examine the use of State-EPA agreements as a means of encouraging professional workforce planning.

- In occupations supporting hazard assessment, EPA will keep advised of the shortages in toxicology and related fields.

- EPA has advertised for proposals to establish three university centers of specialization in the research fields of epidemiology, ground water protection, and advanced waste treatment techniques.

- Various universities are under agreement to EPA to provide "Area Training Centers" which will provide short-term training courses in air pollution control.

- EPA will consider combining selected research and training activities at a single location to determine the effectiveness of such an approach.

- Priorities among various types of workforce development have been established by EPA. They range from analyzing and planning for national workforce needs to evaluation and feedback on program effectiveness.

- EPA is encouraging State self-sufficiency in environmental programs and EPA control agency support has nearly doubled in recent years.

1. BACKGROUND

For over a decade, the Environmental Protection Agency (EPA), and its predecessors, have promoted the development of an environmental workforce through financial assistance and support to various universities. The result of this effort has been a growth in the number of professional workers capable of dealing with the complex problems in the environmental field.

2. PURPOSE OF THIS REPORT

The Congress, in acting on EPA's budget for FY 1979, added funds to the Administration's budget request for the purpose of supporting academic training in the environmental field. Funds for this purpose had not been included in the budget request. In adding the funds to EPA's budget, the committee stated:

> "The Committee recommends the addition of $1,500,000 for academic training and directs the agency to report no later than January 1, 1979, on its evaluation of the supply of professional manpower over the next decade and on available graduate training resources. The report should contain conclusions and recommendations as to the proper role of the agency in resolving these problems."1/

This report is in response to that request from Congress.

3. EPA's MISSION

EPA was established to protect the environment and the American public against threats posed by physical, chemical, and biological agents. To pursue this mission, the EPA (1) establishes criteria, standards, and guidelines to control environmental pollutants; (2) takes enforcement actions to ensure compliance with the Agency's regulatory actions; (3) maintains monitoring programs to assess changes in pollution levels and emissions over extended periods of time; and (4) provides support for municipal, State, and other environmental programs. Accomplishing these goals requires a vast specialized workforce that was not readily available when the EPA was established. Thus, the EPA embarked on an environmental workforce building program.

4. HISTORICAL PATTERNS OF GRADUATE TRAINING SUPPORT

In carrying out its responsibilities in the late 1960's and early 1970's, the EPA and its predecessor agencies experienced a general

shortage of college graduates with pollution control skills. This shortage of adequately trained professionals in the public and private sectors was due to the unavailability of appropriate university curricula. Thus, there was widespread need to upgrade and expand academic course offerings for university students interested in environmental occupations. The general fields of science and engineering did not prepare graduates for the emerging occupations in pollution control.

The EPA response was to use its academic training authorities to provide a wide range of scholarships, fellowships, traineeships, and institutional support (for academic departments) to meet a portion of the need. The support was intended as start-up or seed money to provide an incentive for universities to upgrade their environmental offerings and to recruit students for these occupations. At the height of the program in FY 1971, over $12 million was provided annually to more than 130 universities. Tables I and II summarize EPA's academic training activities in the air and water pollution control programs from 1972 to 1980.

Evidence that the increased funding support of the late 1960's through early 1970's was accompanied by an increase in graduates is clearly stated in a paper published in the February 1979 American Journal of Public Health entitled "Trends in University Environmental Health Research and Training" by D. Moeller, H. Pahl, and P. Hammond.2/ The increase in graduates was from 260 to 650 in a 12 year period. Some of the findings at the Master's level (the level most frequently funded by EPA academic training support) were:

> "The data show that the total number of Master of Science degrees (650) awarded in academic year 1974-75 (the latest year for which complete data were available), was two and one-half times the number (260) awarded in 1966-67. Although the annual number of graduates increased steadily from 1966 through 1973, the number then leveled off and declined in 1975. Of the MS degree graduates for academic year 1974-75, over one-half (53 percent) were in the specialty area of water pollution; an additional 12 percent were in air pollution; and 11 percent were in occupational health. These three specialty areas thus accounted for 76 percent of the total. Training in radiation protection accounted for nearly 6 percent, with epidemiology, toxicology, and cancer research each accounting for 2 to 3 percent."

In interpreting the data, the authors stressed the leveling off and decline in MS graduates in the period after 1973. However, the decline was from 650 to 550 (in 74-75 to 75-76) and was heavily influenced by a decline in water pollution graduates.

The overall point made by Moeller, et al, is that decreasing funds for environmental health training:

> "...has lead to a corresponding decrease in the rate of production of the types of skilled manpower needed, and supplementary data indicate that there are shortages of skilled professionals in many environmental specialty areas. This is particularly true with respect to highly trained research specialists."

While EPA is reviewing the findings cited by Moeller, et al; the decline does not seem to warrant a return to larger scale academic training support of the past. There is little evidence to show that declining levels of EPA support for air and water pollution training will be accompanied by a return to the low levels of graduates characteristic of the mid 1960's. A more detailed discussion on the supply of professional manpower follows.

The Supply of Professional Environmental Manpower

Designing a forecasting model which accurately estimates the availability (supply) of qualified individuals for pollution control occupations is difficult. Some shortages in supply are actually the result of low salary offers by State and local agencies. Graduates from specific degree fields do not necessarily take jobs in their major fields of study. There is a low correlation between occupational titles and major fields of academic study. Cross-training from one field to another as well as the upgrading of individuals through on-the-job training are other patterns which increase the supply of the professional environmental workforce. The result is that forecasting models are subject to many qualifications.

Due to these uncertainties, the National Academy of Sciences (NAS), in its 1977 study on pollution control manpower, made many qualifications on its findings. On the subject of environmental engineers the report said:

> "It is difficult to assess the adequacy of the supply of environmental engineers to meet future requirements. On the one hand, the number of graduates from graduate level environmental engineering programs, about 500 in 1975, seems small for the nation's ongoing commitment to a cleaner environment. On the other hand, in the past a considerable labor market adjustment has occurred to meet actual demand. The supply of new entrants from formal training programs has been augmented by transfers from related occupations. The workings of this adjustment process have increased the stock of environmental engineers well beyond those produced by the schools."3/

TABLE I: AIR POLLUTION TRAINING ACTIVITIES SUPPORTED
BY EPA INVOLVING ACADEMIC INSTITUTIONS

Activity	Fiscal Year								
	1972	1973	1974	1975	1976	1977	1978	1979	1980
Grants to Universities									
Funds ($1000)	2600	1800	1500	1200	472	350	350	266	0
Number of schools involved	43	24	18	12	9	13	11	8	0
Number of trainees supported									
Technicians	175	100	0	0	0	0	0	0	0
Bachelor's level	50	25	0	0	0	0	0	0	0
Master's level	260	240	180	120	68	54	38	32	0
Doctorate level	0	0	0	0	0	0	0	0	0
Total	485	365	180	120	68	54	38	32	0
Special Programs at Universities *									
Funds ($1000)	427	401	360	335	253	250	250	90	0
Number of schools involved	4	4	4	4	3	3	3	3	0
Fellowship Training									
Funds ($1000)	180	370	451	524	591	570	500	184	0
Number of trainees									
State & local agency - full-time	0	14	32	38	37	25	18	16	0
State & local agency - part-time	0	6	32	31	18	10	15	0	0
Other trainees	25	33	22	25	80	15	23	0	0
Total	25	53	86	94	135	50	56	16	0
Total Funds ($1000)	3207	2571	2311	2059	1316	1170	1100	540	0

*Includes internship program at NECEP; Environmental Management Institute at University of Southern California; mechanic training materials development at Colorado State University; and university based seminars

NOTE: NECEP is the New England Consortium for Environmental Protection, a group of universities which cooperates on curriculum plans, dual degree programs, etc.

TABLE II: WATER POLLUTION TRAINING ACTIVITIES SUPPORTED BY EPA INVOLVING ACADEMIC INSTITUTIONS

Activity	Fiscal Year								
	1972	1973	1974	1975	1976	1977	1978	1979	1980
Grants to Universities					'	"	"	"	
Funds ($1000)	4,650	5,937	3,574	2,174	2,121	420	490	240	0
Number of schools involved	103	108	65	52	38	36	38	29	0
Number of trainees supported									
Technicians	0	0	0	0	0	0	0	0	0
Bachelor's level	0	135	130	130	227	41	82	20	0
Master's level	1,295	1,001	876	595	462	93	92	46	0
Doctorate level	0	0	0	0	0	0	0	0	0
Total	1,295	1,136	1,009	705	669	134	174	66	0
Fellowship Training					*	**	**	**	
Funds ($1000)	0	0	230	338	394	154	310	170	0
Number of trainees									
State & local agency—full-time	0	0	38	52	48	22	30	15	0
State & local agency—part-time	0	0	0	21	49	36	71	35	0
Other trainees	0	0	0	0	0	0	0	0	0
Total	0	0	38	73	97	58	101	50	0
Total Funds ($1000)	4,650	5,937	3,804	2,512	2,515	574	800	410	0

' $735K was from Congressional add-on
" All from Congressional add-on
* $50k was from Congressional add-on
** All from Congressional add-on

To supplement the limited data on graduates, the NAS report also considered enrollments for 1975. In that year, 3131 students were enrolled in 10 categories of pollution control training at the graduate level of which 35 percent were part-time. The ten fields covered were: environmental engineering, sanitary engineering, air pollution, solid waste, industrial hygiene, radiological health, environmental control, environmental design and management, and environmental science and water resources.

In interpreting the data on enrollments and graduates, the NAS observed:

> "...young professionals in entry level positions in environmental agencies were upgrading their skills through advanced level study. Part-time study also implies that individuals and their employers are assuming the costs of training programs. Such commitments reflect both careful individual assessment of local career opportunities and a sensible mode of financing professional education."4/

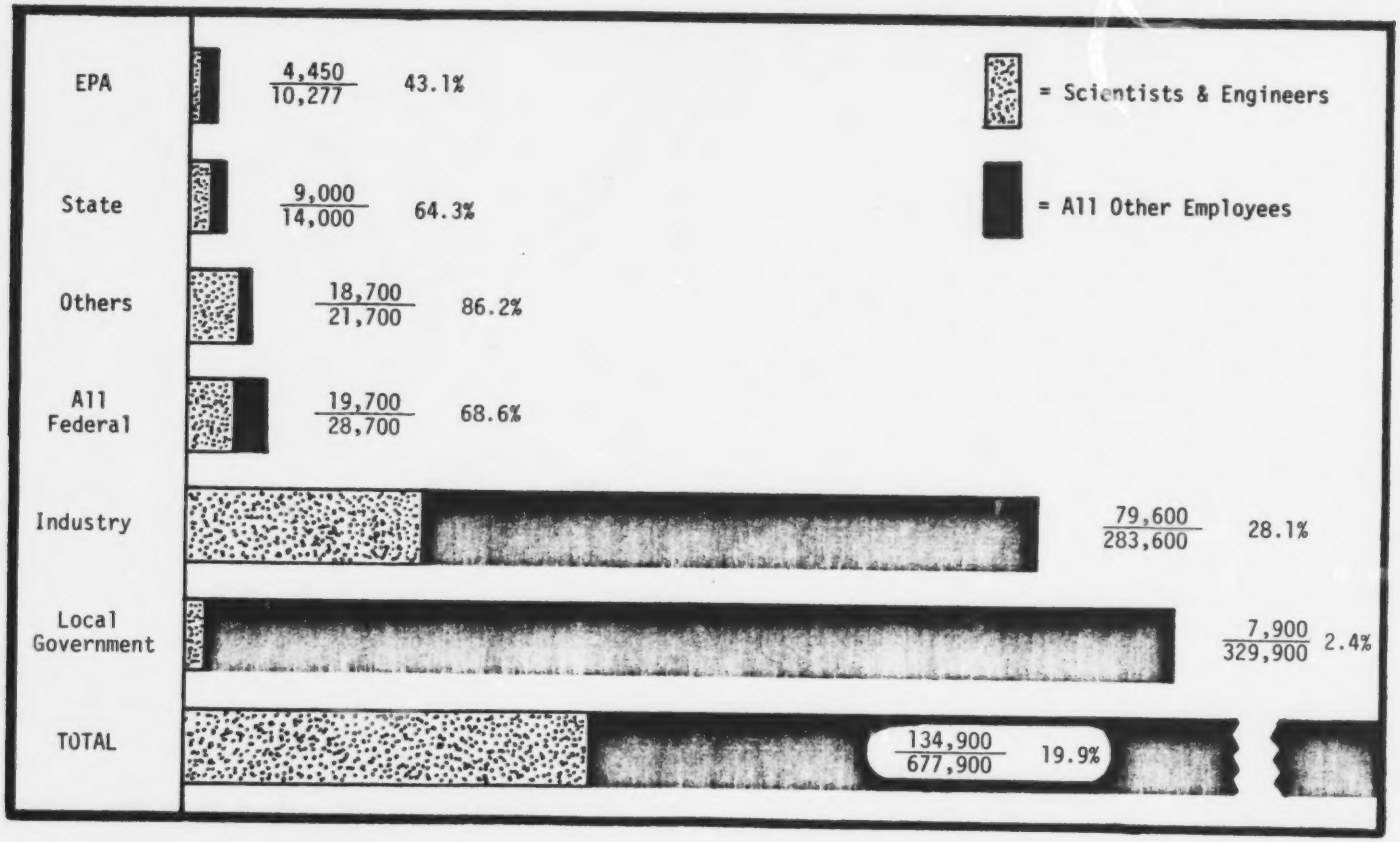
The information presented in the preceding pages does not point clearly to either a shortage or a surplus. However, there is support for the EPA contention that decreased program funding does not necessitate a decrease in manpower, but rather that certain market forces in the private and public sectors will tend to govern the supply of professionals without continued Federal funding. The bar graph on page 7 shows that of the total number of people in the environmental workforce, only a small percentage are directly employed by the Federal Government, and of the 135,000 environmental scientists and engineers, only 20,000 are Federally employed. The remainder of this workforce is employed by States, industries, and local governments (i.e., the free market.)

In conclusion, with an influx of funding to various universities in the late 1960's and early 1970's for training in pollution control, the initial objective of encouraging the formation of departments and the enrollment of students has been met -- at least in part. At present, there is little objective information to show whether or not the supply of graduates is adequate in comparison with demand.

In response, the EPA, having established national environmental programs and a corresponding demand for an environmental workforce, should now assume the role of an assessor of the environmental job market. With published periodic forecasts of job opportunities for environmental professionals, EPA will enhance labor market knowledge of the needs, and will help the self-supported, postsecondary education system produce graduates as needed in the labor market.

ESTIMATED EMPLOYMENT IN ENVIRONMENTAL POLLUTION CONTROL ACTIVITES

From Manpower for Environmental Pollution Control; Volume V
National Academy of Sciences, Washington, D. C. 1977



5. FACTORS AFFECTING EPA SUPPORT OF ACADEMIC TRAINING

A significant factor influencing support for academic training is the belief that the labor market mechanism will induce an adequate supply of trainees and graduates to meet the needs of environmental employers. An elaboration of this concept is that students contemplating large expenditures for postsecondary education will tend to pursue skills for which jobs are available.

The counter argument to the market concept is that it works much less effectively in highly specialized occupations in which there is a thin demand for a skill. Some examples are air pollution meteorologists and design engineers for land application of waste water systems. Since the employment market is very limited for such graduates, students and academic departments must be provided with added incentives to assure the production of graduates. Such an approach - it is argued - is the only assurance that some specialized subjects will be offered in the country.

A second factor affecting EPA support for academic training has been the overall policy of encouraging State self-sufficiency in environmental programs. The basic policy in this regard has been to encourage work-force planning at the State level as well as to encourage the use of in-state university systems to meet professional training needs. Funds for such agreements have doubled in recent years. While this effort has met with limited success, EPA will make an effort to add workforce planning into State-EPA agreements on control agency support. At present most States have done relatively little either to assess or to meet their needs in the pollution control workforce. Michigan, New York, and Texas are significant exceptions to this pattern of little or no workforce development.

A third factor affecting support for academic training has been the steady increase in EPA authority and responsibility without accompanying increases in resources. As the demand for resources has escalated, the Agency has been compelled to adopt rigorous procedures for setting priorities and allocating its budget. Competing requirements have displaced academic training as a high priority Agency objective.

A fourth contributing factor has been an awareness of the historical pattern of "overkill". Developing manpower to the point of surplus has been an occasional pattern in Federal programs. The post-Sputnik push to train scientists and engineers as well as the 1960's efforts to produce teachers are examples of this pattern. Such programs took the general approach of increasing the overall workforce pool through pre-employment training. The high per capita costs of such efforts have caused the mission-oriented Federal agencies to shift toward specialized, upgrade training for skills related to their programs and away from pre-employment training of individuals. A major exception to this trend is in the health area in which substantial support is still provided. (For more on this, see the section in this paper on environmental and health sciences.)

The factors cited, and the NAS Report on pollution control manpower point to a general condition in which adjustments are needed on the State and regional levels. In most States and multi-state regions, the universities presently have the capability to meet various environmental training reeds. However, these university systems could be better utilized if State environmental agencies would provide the universities with items such as:

- Regular assessments of the demand for pollution control professionals.
- Advice on curricula changes (skills likely to be in demand).
- Internships, work-study opportunities, and on-the-job training to graduate and undergraduate students.
- Contracts and grants for short course training and special consulting needs.

It should be the role of EPA to encourage and support State agency leadership by providing special technical and financial support as appropriate.5/

In conclusion, the key factors affecting EPA support of academic training are (1) the concern over causing an "overkill" effect similar to the post-Sputnik push for scientist and engineers in the 1960's; (2) a policy of encouraging State self-sufficiency in environmental programs; and (3) the lack of State and regional data on where critical shortages exist.

In response, each major EPA program will forecast its five year workforce needs (at least for specialized pollution control skills in the public sector) periodically. In addition, State-EPA agreements should encourage and stimulate planning for professional workforce needs through control agency grants.

6. UNIVERSITY CENTERS AND EPA SUPPORT FOR ACADEMIC TRAINING

In March of 1978, EPA completed a report to the President and the Congress on the Agency's assessment of ways for meeting long-term research needs.6/ A key finding of the report was that:

> "Approximately five to ten centers of expertise should be supported primarily at existing institutions with specialized expertise. New centers should be established only when unique circumstances are present. Approximately $500,000 to $1 million will be required annually to support each center."

In FY'79, EPA has requested proposals to establish three University Centers in the specific fields of epidemiology, ground water protection, and advanced waste treatment techniques. The Centers will receive priority consideration for research and development grants in their respective areas. It is expected that each Center will become a national focal point for its particular specialty, offering graduate research and training services to many individuals and organizations.

Research grant support from EPA to universities has been over $40 million annually in recent years. In FY'78, roughly 600 of the 760 grant awards made for research went to academic institutions. In FY'77, 28 institutions had five or more EPA research projects. The Minority Institutions Research Support (MIRS) program was begun in 1972. In six years of operation, a total of $4.7 million was obligated to minority institutions. In fiscal years 80 and 81, the program is to be increased. In addition, arrangements will be made for graduate students from minority institutions to conduct thesis and dissertation research at EPA laboratories.

In FY'77, EPA began conducting some short-term training courses under contract with universities in locations across the country. In FY'79 these institutions, called "Area Training Centers", will provide 41 courses on ten different subjects. This mechanism allows the air program to conduct more of its courses in the field rather than at Research Triangle Park, N.C., the home base of the Air Pollution Training Institute.7/

It is the hope of the Air Program that these area training centers will engage in other training activities beyond those exclusively funded by EPA. A list of potential activities might include:

- Conducting workshops, seminars, and conferences;
- Arranging for graduate and undergraduate internships and co-op relationships;
- Conducting training courses for groups other than EPA; and
- Providing consulting services on specific problems.

In the coming years, it may become desirable to concentrate various forms of EPA training support at these centers. High quality, graduate education in pollution control subjects requires a minimum of 10 graduate students and perhaps as many undergraduates to justify a reasonable selection of course offerings.

Support for graduate training, fellowships, short-term technical courses, internships, engineering extension services, and curriculum development will be concentrated at these schools to the extent possible.

7. PRIORITIES AMONG VARIOUS TYPES OF WORKFORCE DEVELOPMENT

Academic training is one of several tools used by EPA to encourage individuals to pursue environmental occupations. Workforce development is the generic term which covers the full range of tools and activities. Although the tendency is to visualize workforce development as training only, many other factors enter into the process - particularly for the non-Federal workforce. Salary structures, recruiting techniques, certification systems (for professionals and technicians), and occupational definitions are a few additional factors which must be considered in workforce development.

The following list of activities is arranged according to the prevailing priority ranking in EPA's eight major program areas. Although some programs would rank the activities differently in a given fiscal year and some programs would do only the first one or two items, the overall ranking would tend to be as shown.

1. Analyzing and planning for the workforce needs of national environmental programs.

2. Conducting direct training through short courses by Federal employees and contractors. Such courses are specialized, related to program needs and usually are not offered elsewhere in the nation.

3. Finding and using extra-mural resources such as co-op students.

4. Working as a catalyst to induce independent and self-supported learning through public and private educational institutions.

5. Assisting State lead agencies in building local capabilities which address their human resource needs.

6. Providing operation and maintenance on-site assistance for pollution control equipment.

7. Supporting and encouraging certification standards for environmental occupations.

8. Providing expertise in the form of ideas, contracts, course offerings, grant opportunities, and national meetings.

9. Sponsoring fellowships, traineeships, scholarships, forgiveable loans (when graduates accept public sector jobs), and institutional support (to academic departments).

One additional activity which applies to all of the above is evaluation and feedback on the effectiveness of the various activities.

While the ranking process has tended to displace academic training as a high priority workforce tool, other inherent aspects of graduate support have also contributed to a lower ranking. The long lead times to obtain the benefits of graduates and the tendency of graduates to return to school or accept jobs outside the public sector are factors which tend to decrease the incremental benefits of such expenditures.

The conclusion to be drawn from this analysis is that academic training tends to have a lower priority in comparison with other workforce development tools and activities. However, one role which EPA is exploring, as noted in the previous section, is the combining of the University Center's approach used for research on specialized needs with the Area Training Center approach used by the Office of Air Quality Planning and Standards. Both types of centers are based on concentrating EPA resources among a few universities willing to commit substantial resources of their own. This approach may be effective in meeting some of the specialized needs in hazardous waste management.

Thus, EPA has concentrated some of its resources in research and training among a few universities in order to provide a base for other activities to occur without direct EPA support. In FY'81, EPA will consider sombining selected research and training activities at a single location in order to determine the effectiveness of such an approach. In addition, the Agency will consider the expanded use of area training centers in other programs besides air pollution control.

8. ISSUES IN TOXIC SUBSTANCES AND RELATED FIELDS

For some skills in the life and health sciences (frequently called biomedical sciences) needed to support the activities of EPA's Office of Toxic Substances, the Agency does not have explicit academic training authority. However, EPA is experiencing shortages in some occupations needed to implement the Toxic Substances Control Act (TSCA) and the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). These statutes are concerned with the assessment and control of chemical hazards to human health and to ecosystems.

EPA's position on development of professional manpower to support TSCA and FIFRA activities is that the several other Federal agencies with relevant mandates and administrative mechanisms for academic training should continue their activities, and should provide support to certain specified disciplines.

Some 13 Federal agencies, including EPA, administer some 25 statutes passed during the last 15-20 years to regulate chemicals and other hazardous materials. In addition to TSCA and FIFRA, several other statutes administered by EPA provide authority to deal with various toxic and hazardous substances problems. Several other Federal agencies have responsibilities for evaluating and/or controlling chemical hazards to health and the environment. They include the Center for Disease Control,

National Institute of Occupational Safety and Health, Food and Drug Administration, Department of Labor, Department of Energy, Department of Defense, Department of Commerce, Department of Agriculture, Department of Interior, Department of Transportation, and the Consumer Product Safety Commission. In many cases, the personnel needs of the various agencies are similar in that a variety of life (or biological) scientists, as well as physical and chemical scientists and engineers, medical and public health scientists, mathematical and statistical and social scientists are utilized. Biomedical scientists -- a term which refers to both life and health scientists -- predominate; the other disciplines supplement and support these biomedical scientists.

The major conclusion which can be drawn is that EPA, as well as other agencies, need scientists in toxicology and related fields. Because of EPA's role as a regulatory agency, the assumption of an obligation to support academic training in biomedical and other environmental sciences is not considered appropriate. The Agency role will be to keep advised of workforce assessment efforts in toxicology and related fields. EPA will also encourage academic training support by other agencies to remedy specific shortages.

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3. National Academy of Sciences, "Manpower for Environmental Pollution Control", Analytical Studies for the US Environmental Protection Agency, Washington, D.C., 1977, page 233.

4. National Academy of Sciences, op cit, page 233.

5. For more discussion on the State-EPA role in workforce development, see: Cluster, R.C., "Training and Education of Environmental Health Manpower: EPA Perspective" (editorial) American Journal of Public Health, Vol. 69, February 1979, pages 118-119.

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